WARMING UP THE ENGINE

Someone observed that he intended to add a means of turning off the headlight while warming up the bike, trail riding, etc. I think the reason was to save watts. I understand that the KLR charging system uses load type regulation, in other words it simply adds its own electrical load to drag the system voltage down to the maximum set point to prevent over charging or overload of components due to too high a voltage. With this system the alternator puts out 100% all the time, regardless of what is on or off so shutting off the headlight will not save watts or reduce the mechanical load on the engine. The added visibility due to headlight on has been well documented in studies so the ability to turn off the light while riding would seem to be undesirable because it will add another failure point for an unused option. Turning the light off while trail riding may have some advantage in that it may reduce undesired attention if riding in areas such as private property without permission :-)

As to warming up the bike.......hmmm do I really want to open up that can of worms? People have actually called me names for my stand on this one but keeping in mind that I'm speaking from the reference of technical background, experience and large scale studies - (probably why some got mad!

The engine should be run for a short time prior to riding, if the proper SAE weight of oil is being used, because warming at low engine load will contribute to higher engine wear. No to state the case too strongly, IMO if you are warming up your engine at idle before riding you are in error. Engines wear very little when they are operating in the normal operating range because there is good lubrication due to oil flow and there is practically no washing of the cylinder walls by impinged fuel.

Let's consider the fuel delivery system: The carburetor or fuel injection system's job is to deliver fuel in the correct proportion to air, mix the fuel and air thoroughly, provide the tiniest fuel droplets possible (same as mixing I guess but wanted to emphasize), and provide the desired quantity of air fuel mixture for needed engine power output.

As we all learned in school, the ideal proportion of air to gasoline for is 14.7:1 by weight. In other words 14.7 pounds of air to one pound of fuel as an example. More fuel than that is called a "Rich" mixture and will result in poor fuel economy because there isn't enough air present to burn all the fuel. IN a rich mixture some unburned fuel will be present in the form of higher hydrocarbons in the exhaust. In addition, the greater mass of the air fuel mix will result in lower combustion chamber temperature which will result in less expansion (pressure) on the combusted mixture. Less pressure in the combustion chamber means less force applied to the piston which equals less power. Less power from a given volume of air fuel mix means that a larger throttle opening (more air fuel mix) will be needed to do the same work so poorer fuel economy will result.

Back to the carburetor. The carburetor uses the venturi effect as is discussed in the KLR carburetor article I saw on someone's site. The venturi effect is simply the effect of introducing a small restriction into the air flow for the purpose of creating a low pressure area. A low pressure area that is lower in pressure than the fuel in the carburetor's float bowl...

Oh, oh - here we go, these things always start to balloon: The float system (bowl, float, needle valve and seat are used to maintain a constant fuel level in the float bowl so that a constant fuel pressure is present in the bottom of the float bowl This constant fuel pressure is useful in allowing a predictable fuel delivery to the idle and main fuel delivery systems. (More on that later I hope in another article.)

If the fuel pressure is constant to the idle and main delivery systems then changes in the air pressure at the outlet of the idle or main fuel delivery system will be reflected in changes to the amount of fuel delivered. The better the carburetor (carb) design, the better job the carb does in providing a well mixed, uniform fuel delivery at the correct ratio. In lay terms, the carb uses vacuum to suck the right amount of fuel through the idle and/or main circuit into the inlet air stream. The throttle controls the amount of air (more air more power) and the carb makes sure the right amount of fuel is matched with the airflow rate.

In a "Lean" mixture there is less then the ideal amount of fuel in the mixture which can be an advantage if the condition is not extreme for

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the given engine and gasoline blend. If there is a bit of extra air present it will make sure that all the fuel (or al least more) is able to come in contact with air and be completely burned.

From this it can be seen the advantage of better (more uniform) mixing. The smaller the droplets of gasoline and the better dispersed, the more likely that the fuel will burn rapidly and completely. A well mixed charge of air and fuel will burn more rapidly than a poorly mixed one which can be noticed in the need to reduce timing advance in some old engines when a new (more effective) carburetor is substituted but that's getting off the topic.

Let's consider mixing further: Have you noticed the old carburetor and intake setups on Fords N Series Ford (the little gray ones) ? Model "A" and "T"? All real old engines and most all-small air-cooled engines? The carb is mounted low on the engine and the intake passage or manifold of
passages leads upward to the intake ports. Why? These carbs weren't very capable of delivering the fuel in very fine droplets and evenly dispersing it in the air column. Because many of the droplets were pretty big (huge) they wouldn't burn very well in the combustion chamber but this was handled by having the long, upward intake tract. The effect of gravity tended to act more on the big drops (smaller surface area to mass) than on the small ones so this would slow the big drops, giving more time for the drops to be broken up by turbulence in the column = better mixing. These carbs weren't very effective in atomization - it was more a case of pourization (VBG).

You will have already worked out that a richer mixture is needed when poorer mixing is present, right? Let's look at another consequence of bigger droplets: one thing we don't want is to have fuel droplets sticking (impinging) to the cylinder walls because this will wash off or dilute) the micro-thin layer of oil on the cylinder wall increasing metal to metal contact and increasing wear markedly! If enough fuel sticks to the cylinder walls and the engine is cool
enough, fuel will make it past the compression rings and enter the crankcase where it will dilute lubricating oil to varying degrees. If much fuel dilution is present lubrication will suffer, especially to high-pressure areas such as camshaft lobes. Cylinder wall wear will skyrocket!

What factors will serve to increase fuel impingement?

1) Colder temperatures.
2) Richer/poorly atomized mixture

In order to improve fuel mileage as stated earlier, we can jet a bit lean

so that all fuel is more likely to be burned. The amount depends on engine design, intake air temperature, etc. If we go too far to the lean side we will see slower burning rate (fuel particles are less effective at lighting off their neighbors) and higher combustion temperature. Higher temperatures can lead to higher (NOx, oxides of nitrogen) smog levels, exploding (rather
than burning) of the air-fuel mixture and other undesirable effects. Exploding of the air-fuel mixture (referred to a detonation) can cause catastrophic engine damage!

In a cold engine, fuel does not burn as effectively so we need to introduce extra fuel (rich mixture) for effective running. In addition, poorer carburetors will not deliver as much fuel at cranking speed than at idle because the airflow rate is slower with the engine pumping less quickly. To deal with the need for extra fuel, most carburetors use a choke to add additional restriction at the inlet end of the carburetor this increases the pressure drop (vacuum- suction) at the idle and main circuit outlets, resulting in a richer fuel-air mixture. Some chokes are automatic deployed and proportioned according to engine temperature while most motorcycle carbs of this type use a manually controlled system.

The KLR and many bikes approach this problem differently: they KLR system adds an enrichment circuit (manually controlled), which opens a larger fuel delivery circuit resulting in a richer air-fuel mixture for starting.

Now to the crux:

When the engine is operating during warm-up the colder intake passages, colder piston and cylinder walls will allow fuel droplets to stick and not immediately evaporate off. In this condition, liquid fuel will flow along the walls of the intake and down into the cylinder, resulting in washing of the cylinder walls and increased wear. The longer the warm-up phase continues, the longer increased wear will take place. I know many of you do not want to hear this because it speaks to some cherished beliefs but there it is. There is no possibility that the conclusion is wrong!

The best practice is to use oil of the correct SAE range (IMO most people use too heavy an oil but that's another can of worms), start the engine and after a brief time (such as donning one's gloves), proceed off using low engine load until the operating temperature comes into the normal range. There are reasons to warm up completely at idle such as needing low speed tractability but this is unlikely. If you insist on idling to warm up, that's OK as it's your bike and you have every right to operate it that way as you paid for it and pay for the maintenance. This is not a crusade with me and I don't look down on those who choose otherwise. On the other hand I hope that this article may prove useful for someone.

Some appendix observations:

1) Consider what happens if the thermostat stays open or is removed.... Yes, the engine stays at lower temperature almost all the time. Consider the lower life of raw water (sea water through the engine cooling system) versus heat exchanged (cooling system with corrosion inhibitor such as antifreeze which passes heat to sea water through a heat exchange system). The raw water system has to run at lower temperature or minerals from the seawater will plate onto the inside of the engine cooling passages. Because the raw water systems don't run at 180 or 195 degree F like is more desirable the engines last a fraction of the time.

2) I've seen rebuilt engines worn out completely (12 to 15 thou of cylinder taper) in one winter where the manifold cross over passage (which heats the automatic choke) was plugged.

Fuel contamination is yet another reason for more frequent oil change intervals if operating for short runs than long distance touring.